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MEMORANDUM

CH2MHILL

Proposed Methods for Preparing the Human Health Risk Assessment for SWMUs 2B, 2C, and 2E at Naval Air Station, Oceana

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This memorandum presents the methods that will be used to prepare the human health risk assessment (HHRA) for SWMUs 2B, 2C, and 2E, at NAS Oceana.

1. General Information about the SWMUs

Some general information on the results of investigation activities at the SWMUs that will be used in the HHRAs is provided in Attachment A.

2. Data Selection and Evaluation

Investigation data was collected between 1993 and 1999 during multiple field activities at each SWMU. Data that have been fully validated will be evaluated in the risk assessment. Historic (i.e., pre-1993) soil data have not been validated, but will be evaluated to determine whether they are of sufficient quality for inclusion in the risk assessment. In some cases, only historic soil data is available for a SWMU. The following bullets discuss how qualified data will be evaluated in the risk assessment, and additional data handling and evaluation issues:

- Data qualified with a J (estimated) will be treated as detected concentrations and will be included in the calculation of summary statistics without modification.
- Data qualified with an R (rejected) will be excluded from the risk assessment.
- Data qualified with a B (blank contamination) will be used in the risk assessment as if it is non-detect and one-half the sample quantitation limit (SQL) or sample detection limit (DL) will be used as the sample.
- For duplicate samples, the higher of the two concentrations will be used. In calculating the frequency of detection, mean and the 95 percent upper confidence limit of the mean (95% UCL), the duplicates will be counted as a single sample.

- One-half the sample quantitation limit (SQL) or sample detection limit (DL) will be used in place of non-detect results in calculating summary statistics for analytes having one or more positive results in a particular medium.
- Analytes for which no positive results are reported for a particular medium will not be considered contaminants of potential concern for that medium.

3. Selection of Contaminants of Potential Concern (COPCs)

The methodology presented in EPA Region III's *Selection of Exposure Routes and Contaminants of Concern by Risk-Based Screening*, (EPA, 1993) will be followed to determine which constituents will be evaluated quantitatively in the HHRAs. The following bullets discuss this methodology as it pertains to SWMUs 2B, 2C and 2E at NAS Oceana:

- Maximum concentrations of constituents detected in soils will be compared to the current EPA Region III Risk-Based Concentrations (RBCs) for residential soil. RBCs that are based on noncarcinogenic effects will be divided by 10 to account for cumulative exposure. RBCs based on carcinogenic effects will be used as presented in the most current RBC table (EPA, 2000). Constituents having a maximum detected concentration less than the lowest applicable soil RBC will not be retained as soil COPCs for the HHRA.
- Maximum concentrations of constituents detected in groundwater using data from all on-site monitoring wells will be compared to the current EPA Region III RBCs for tap water. RBCs that are based on noncarcinogenic effects will be divided by 10 to account for cumulative exposure. RBCs based on carcinogenic effects will be used as presented in the most current RBC table (EPA, 2000). Constituents having a maximum detected concentration less than the lowest applicable tap water RBC will not be retained as groundwater COPCs for the HHRA.
- RBC values are not available for sediment. In addition, residential soil RBCs are based on exposure assumptions that are not applicable to incidental contact with sediment. As such, screening of COPCs in sediment will be based on comparison of maximum concentrations of constituents detected in sediment to ten times the values used to screen for soils, as follows. RBCs that are based on noncarcinogenic effects will be used as presented for residential soil in the most current RBC table (EPA, 2000). RBCs based on carcinogenic effects will be ten times the current EPA Region III RBCs for residential soil. Constituents having a maximum detected concentration less than the lowest applicable sediment RBC will not be retained as sediment COPCs for the HHRA.
- RBC values are not available for surface water. In addition, tap water RBCs are based on exposure assumptions that are not applicable to incidental contact with surface water. As such, screening of COPCs in surface water will be based on comparison of maximum concentrations of constituents detected in surface to ten times the values used to screen for groundwater, as follows. RBCs that are based on noncarcinogenic effects will be used as presented for tap water in the most current RBC table (EPA, 2000). RBCs based on carcinogenic effects will be ten times the current EPA Region III RBCs for tap water. Constituents having a maximum detected concentration less than the lowest applicable surface water RBC will not be retained as surface water COPCs for the HHRA.
- Constituents that are essential human nutrients (e.g., iron, magnesium, calcium, potassium and sodium) will not be considered further in the quantitative risk

assessment as they are typically present at low concentrations (i.e., at or near naturally occurring levels), and are toxic only at very high doses.

4. Exposure Assessment

Exposure Point Concentrations

The exposure point concentration (EPC) for the reasonable maximum exposure (RME) scenario will be based on the 95% UCL for datasets having five or more samples. In other cases, the EPC for the RME case will be the maximum detected value. The maximum detected concentration will also be used when the calculated 95% UCL is greater than the maximum detected value. The Shapiro-Wilks W test using an alpha value of 0.01 will be used to determine if the data fit a lognormal or normal distribution. If the W-test is inconclusive, the 95% UCL that best fits the data as indicated by the higher W-test value will be used. For the exposure point concentration for the central tendency evaluation, the arithmetic mean value of either the transformed or untransformed dataset will be used. The maximum detected concentration will be used in place of the arithmetic mean when the mean is greater than the maximum detected value.

The EPCs for groundwater for the future resident scenario will be determined using data from only the most contaminated wells (i.e., wells within the groundwater contamination plume). Conversely, the EPCs for groundwater for the construction worker scenario will include the data from all of the monitoring wells and not just the most contaminated well or group of wells. The assumption is that the groundwater from across the entire site, and not just the groundwater associated with the most contaminated well or group of wells, will infiltrate the excavation trench in this case.

For surface water, sediment and soil related exposures, the EPCs will be based on the entire data sets that are: 1) deemed to be of adequate quality to support quantitative health risk analysis; and, 2) representative of the assumed exposure points.

Exposure Scenarios and Pathways

Tables 1a through 1c in Attachment B detail the exposure scenarios and pathways that will be evaluated in the HHRA for each SWMU at NAS Oceana. Please note that scenarios and pathways associated with exposures to surface water and sediment are applicable to SWMU 2B only. All other scenarios and pathways will be utilized in the analyses for SWMUs 2B, 2C and 2E. The scenarios and pathways that are applicable to current and future conditions at each SWMU are discussed in greater detail below.

Current Scenarios and Pathways

Groundwater is not currently used as a potable water supply at NAS Oceana. The municipal water supply is in place at the facility that will remain so in future. In addition, there are no off-site groundwater residential receptors downgradient of NAS Oceana. Therefore, pathways associated with current groundwater use at the facility are incomplete and will not be included in the quantitative analysis.

Pathways associated with direct and indirect contact with surface soil may be complete for adult industrial workers currently engaged in occupational activities in unpaved areas within the SWMUs. Exposure routes may include incidental ingestion, dermal contact and inhalation of vapors or entrained particulate matter. Given the degree of activity, restricted access, and amount of security common to the site, the likelihood for unauthorized access to the areas within the fencelines is considered negligible. Therefore, soil related exposure pathways for a trespasser/visitor scenario are considered incomplete under current conditions.

A drainage ditch is present in the area outside the fenceline at SWMU 2B. Sediments and surface water in this drainage ditch may have been impacted by releases from within the SWMU. In addition, access to this area is not as tightly restricted as that to areas within the fenceline. As such, direct contact with impacted surface water and sediment is assumed to be possible under the industrial worker (adult) and trespasser/ visitor (adult and adolescent) scenarios under current conditions. Exposure routes are assumed to include incidental ingestion and dermal contact for all receptor groups under each scenario.

Since the ditch appears not to be a suitable habitat for game fish species, and no recreational angling has been known to occur in the ditch, consumption of impacted fish tissue is considered to be an incomplete pathway. No surface water or sediment is known to be impacted by SWMUs 2C and 2E, therefore pathways associated with these media are not included in the HHRAs for those SWMUs.

Future Scenarios and Pathways

While highly unlikely, there are currently no physical or legal constraints that would preclude the installation and development of a water supply well in the future at any of the SWMUs at the base. Likewise, the type of development that may occur in the future cannot be assumed to be strictly non-residential. As such, the use of the Columbia Aquifer as a domestic potable water supply, through the installation of a domestic well within the SWMUs, will be included in the analysis. Future adult and child residents could be chronically exposed through both direct and indirect contact with impacted groundwater. Exposure routes may include ingestion, dermal contact, and inhalation of vapors generated during showering. The Foster and Chrostowski Model will be used to estimate potential exposure by a residential adult to groundwater while showering.

In addition to the residential scenario, groundwater exposures will also be quantitatively evaluated under a construction worker scenario. It is assumed that adult construction workers may be exposed through direct and indirect contact with shallow groundwater that may seep into trenches or pits dug during future development activities at the site. This scenario should be considered conservative and unlikely to occur in practice since, under normal excavation procedures, the water table would be drawn down to reduce or eliminate groundwater infiltration into the excavation. Because of the relative shallowness and small amount of water likely to be present in an excavation, exposure routes are assumed to limited to dermal contact and inhalation of vapors for this scenario.

Possible future exposure scenarios related to surface soil could include residential, industrial worker and trespasser/visitor. For the purposes of the HHRA, these potential future exposure scenarios conservatively assume that the subsurface soil will be excavated during development and spread over the surface of the site. The potential future exposure to the soil (subsurface becoming surface, and current surface soil) will be evaluated for adult and child residents, adult industrial workers, and adult and adolescent trespassers/visitors via ingestion, dermal contact, and inhalation.

Additionally, future adult construction workers may potentially be exposed to surface and subsurface soil during site development activities. Exposure routes to be considered under this scenario will include ingestion, dermal contact, and inhalation.

Parameter Values for Dose Algorithms

The draft tables included in Appendix C detail the exposure parameters that will be used for quantitative estimation of route-specific intake of each exposure scenario, pathway, and receptor group outlined above and in Appendix B. The references and rationale for the selection of each value are provided in the tables. In general, standard assumptions have been used as outlined in approved USEPA technical guidance. Particularly, for the RME case, the use of such default assumptions in the dose calculations will result in conservative estimates of exposure for all receptor groups. As noted above, deterministic (i.e., point) estimates of chronic daily intake (dose) will be derived for both RME and CT cases for each receptor group. However, CT intakes will only be calculated for those scenarios that have an RME noncarcinogenic hazard greater than 1.0 and/or an RME carcinogenic risk greater than $1x10^{-5}$.

Dermal exposure to groundwater will be assessed through the use of methods outlined in Section 5.3 of USEPA's guidance document *Dermal Exposure Assessment: Principals and Applications* (EPA, 1992). For inorganic constituents, the steady-state approach will be used. For organic COPCs, the nonsteady-state approach will be applied. Algorithms and chemical-specific parameters (e.g., K_{ow}, K_p, etc.) and other constants will be used as presented in Section 5.3 and Table 5-8 of the above referenced document.

5. Toxicity Assessment

Toxicity values for use in the risk assessment will be obtained from the Integrated Risk Information System (IRIS) and Health Effects Assessment Summary Tables (HEAST) databases. If information is not available from these two sources, toxicity values from the EPA Region III Risk Based Concentration Table will be used. If information is not available from the preceding sources, EPA Region III risk assessors will be consulted.

Oral toxicity values will be adjusted from administered to absorbed doses for dermal evaluation using the oral absorption efficiencies provided by the EPA Region III (EPA, 2000).

6. Risk Characterization and Uncertainty Discussion

As noted, the characterization of health hazard and carcinogenic risk will be provided as point estimates for each receptor group under each scenario. To account for cumulative effects, non-carcinogenic hazard will be considered additive based on toxicological endpoint or mechanism of action. Likewise, carcinogenic risk will be assumed additive across all routes of exposure for each receptor group. Special note will be made of chemicals and exposure pathways that account for the majority of potential effects in cases where lifetime incremental cancer risk exceed 1×10^{-4} and/or the non-carcinogenic hazard index exceeds 1.

A qualitative uncertainty evaluation will be included in the risk characterization for each SWMU. The relative degree to which individual assumptions add to or reduce the uncertainty and conservatism inherent in the risk estimates will be discussed and summarized in tabular form per the specified format (EPA, 1998) for each exposure scenario.

7. Risk Assessment Deliverables

The risk assessment will be prepared following the *Risk Assessment Guidance for Superfund: Volume I: Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments)* (EPA, 1998).

The Interim Deliverable tables will be submitted to EPA for review. We are proposing to make 3 separate submittals to the EPA for review prior to submittal of the completed report. The interim submittals will combine the RAGS Part D tables as follows:

- **Tables 1 and 4** -Table 1 summarizes the exposure pathways to be evaluated in the risk assessment. Table 4 defines the exposure parameters to be used in the risk calculations. These tables are provided with this submittal.

- **Tables 2, 3, 5 and 6** - Tables 2 and 3 are similar in that they select the chemicals of potential concern (COPCs) and summarize the concentration statistics for the COPCs. Tables 5 and 6 summarize the noncancer and cancer toxicity values for the COPCs to be evaluated in the risk assessment.

- **Tables 7, 8, 9 and 10** - Show the risk calculations for each exposure scenario. Tables 9 and 10 summarize the risk calculations for each exposure scenario by receptor. Tables 7, 8, 9 and 10 will be submitted as part of RI.

8. References

EPA, 1992. *Dermal Exposure Assessment: Principals and Applications.* EPA/600/8-91/011B. United States Environmental Protection Agency, Office of Health and Environmental Assessment, Washington, DC.

EPA, 1993. *Selection of Exposure Routes and Contaminants of Concern by Risk-Based Screening.* EPA/903/R-93-001. United States Environmental Protection Agency, Region III – Office of Superfund Programs. Philadelphia, PA.

EPA, 1998. *Risk Assessment Guidance for Superfund: Volume I: Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments).* EPA-9285.7-01D. United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC.

EPA, 1999. Facsimile from EPA Region III. *Oral ABS Values for Oral-to-Dermal Extrapolation per RAGS Appendix A*, last updated 4/8/99

EPA, 2000. *EPA Region III RBC Table – 4/13/2000.* United States Environmental Protection Agency, Region III – Office of Superfund Programs. Philadelphia, PA.

Foster, S.A. and P.C. Chrostowski, 1987. *Inhalation Exposures to Volatile Organic Contaminants in the Shower.* ICF-Clement Associates, Inc. Washington, D.C.

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Attachment A

General Site Information

A.1 SWMU 2B—Line Shack 130-131 Disposal Area

SWMU 2B is located southeast of the main MATWING hangar 122. The unit includes Line Shacks 130 through 134, the five aircraft cleaning stations northeast of Line Shack 130 and the meadow and forested area outside the flight line fence.

A.1.1 Investigation History

Prior the RFI, SWMU 2B was investigated in three previous studies: (1) the IAS, (2) the Line Shack SWMU Inspection in 1988, and (3), the Interim RFI in 1990. These studies indicated that groundwater at SWMU 2B is contaminated with chlorinated organics from at least two sources. Also, contamination was detected in sediments collected from a surface-water drainage channel adjacent to the SWMU.

The IAS states that potential contaminants at SWMU 2B may include: oil, hydraulic fluid, turco, paint stripper and thinners, PD 680, and aromatic hydrocarbons (naphtha, benzene, toluene and derivatives), all of which were used in aircraft maintenance activities (RGH, 1984). These waste oils and aircraft-maintenance chemicals were disposed of adjacent to the line shacks in unknown amounts beginning in 1963, when the line shacks were constructed, until the early 1980s (RGH, 1984). A hazardous waste collection and recycling program has been in force throughout the base since 1981. During the 1980s an oil-water separator system was installed in the aircraft cleaning area northeast of Line Shack 130 to separate oil from wash water flowing from the aircraft cleaning area.

In 1993, CH2M HILL conducted a Phase I RFI to (1) define the sources of groundwater contamination, (2) define the source areas through soil sampling, and (3) define the effects of groundwater discharge to surface water and sediment quality. Results are documented in the *RCRA Facility Investigation Final Report – Phase I, Naval Air Station Oceana, Virginia Beach, Virginia,* December 1993.

In 1995 CH2M HILL performed a CMS. The objectives of the CMS were to further delineate the extent of groundwater, soil, and surface water/sediment contamination and to determine the need for remedial activities. Results are documented in the *Final Corrective Measures Study for SWMUs 1, 2B, and 2C, Oceana Naval Air Station, Virginia Beach, Virginia,* November 1995.

Follow-on sediment sampling was conducted by CH2M HILL as part of the Phase III RFI. Phase III FRI Results are documented in the *Final RCRA Facility Investigation Report – Phase III, Naval Air Station Oceana, Virginia Beach, Virginia,* August 1999.

Soil samples collected at SWMU 2B during the Phase I RFI and CMS have not contained significant concentrations of chlorinated VOCs, even when sampling was focused in areas with the highest concentrations of chlorinated VOCs in groundwater. The soil sampling results indicate that that the source areas are probably limited in areal extent. Shallow groundwater at SWMU 2B is contaminated with TCE, 1,2-dichloroethylene, and vinyl chloride. The deep aquifer is not contaminated with chlorinated VOCs. Low levels of chlorinated VOCs were detected in surface water and sediment in both the RFI and the CMS. Sediment samples collected during the Phase I and III RFI have shown the sediments to be contaminated with PAHs at levels that exceed ecological screening levels.

In the CMS, the evaluation of remedial alternatives resulted in the recommendation of the following remedial action: groundwater contaminant plume containment and source-area extraction with groundwater treatment using air stripping. This alternative was not

implemented to allow additional investigation into emerging innovative groundwater remediation technologies.

A.1.2 Current Status

The Navy is planning a HHRA and ERA for SWMU 2B. The HHRA will be conducted following the assumptions and protocol as agreed upon with the EPA. The ERA will be conducted following the process defined in the *Technical Memorandum – Ecological Risk Assessment Approach for SWMUs 1, 2B, 11, 15, 16, 21, 22, 25, and 26, Naval Air Station Oceana, Virginia Beach, Virginia* (January). Following the risk assessments the Navy will proceed with a focused FS, a PRAP, and a ROD for SWMU 2B.

The reach of the drainage channel that has contained the contaminated sediments is currently being re-engineered to accommodate the construction of additional maintenance hangers and a parking lot. Much of the old drainage channel is expected to be altered or filled in. Construction in the area began in winter of 1998 and is expected to be completed in FY02.

A.2 SWMU 2C - Line Shack 400 Disposal Area

SWMU 2C is encompassed by Line Shack 400 and Buildings 301, 401, and 404. This general area, which is part of FITWING, has been and continues to be used for aircraft maintenance and cleaning. In earlier years, Navy personnel disposed of various maintenance and cleaning chemicals similar to those discharged at SWMU 2B. These chemicals potentially include waste oil, hydraulic fluid, PD 680, paint stripper, thinner, Turco, naphtha, and B&D 3400 Engine Cleaner (RGH, 1984). Waste disposal occurred near Line Shack 400 starting in 1963, the year the line shack was constructed, until the early 1980s, when a hazardous waste recovery program was instituted (RGH, 1984). The area around the line shack originally had an earthen surface but it was capped with 15 inches of concrete in the early 1980s (RGH, 1984). A disposal area southwest of Building 400 was reported to be visible in 1971 air photographs reviewed during the IAS (RGH, 1984). It is not known if the soil was removed and if so, where it was taken for disposal (RGH, 1984).

A.2.1 Investigation Status

Two environmental investigations at SWMU 2C preceded the Phase I RFI (1) the Line Shack SWMU Inspection in 1988, and (2), the Interim RFI in 1990. These studies indicated that groundwater at SWMU 2C is contaminated with chlorinated VOCs over a broad area.

In 1993 CH2M HILL conducted a Phase I RFI to delineate the areal and vertical extent of the groundwater contaminant plume and the identify probable contaminant source areas in soil. Results are documented in the *RCRA Facility Investigation Final Report – Phase I, Naval Air Station Oceana, Virginia Beach, Virginia,* December 1993.

Subsequently, CH2M HILL conducted a CMS in 1995 to further delineate the areal extent of the groundwater contaminant plume and further identify probable contaminant source areas in soil to support a remediation strategy. Results are documented in the *Final Corrective Measures Study for SWMUs 1, 2B, and 2C, Oceana Naval Air Station, Virginia Beach, Virginia,* November 1995.

Follow-on sediment sampling was conducted by CH2M HILL as part of the Phase III RFI. Phase III FRI Results are documented in the *Final RCRA Facility Investigation Report – Phase III, Naval Air Station Oceana, Virginia Beach, Virginia,* August 1999.

Investigation results indicated that vinyl chloride and 1,2-dichloroethylene are the primary chlorinated VOC groundwater contaminants at SWMU 2C. The contaminant plume extends from the flight line area to the south-southeast, across London Bridge Road. During the Phase I RFI a low concentration of 1,2-dichloroethylene was detected in a well screened in the deep aquifer. The same well was sampled during the follow-on CMS and had no detection of 1,2-dichloroethylene.

A suspected contaminant source area near Building 400 was not precisely located despite the numerous soil samples collected in this area. A suspected contaminant source area near the southeastern corner of Building 301 was verified through soil sampling and the detection of chlorinated VOCs. In the CMS, the evaluation of remedial alternatives resulted in the recommendation of the following remedial action: groundwater contaminant plume containment and source-area extraction with groundwater treatment using air stripping. . This alternative was not implemented to allow additional investigation into emerging innovative groundwater remediation technologies. Sediment samples collected during the Phase III RFI indicated that the sediments are contaminated with PAHs at levels that exceed ecological screening levels.

In July 1999, the Navy completed one round of groundwater sampling from 19 monitoring wells to support a human health risk assessment and to identify the current location of contaminant plumes at SWMU 2C.

A.2.2 Current Status

The Navy is planning a HHRA for SWMU 2C which will be conducted following the assumptions and protocol as agreed upon with the EPA. Following the risk assessments the Navy will proceed with a focused FS, a PRAP, and a ROD for SWMU 2C.

The Navy anticipates implementing an innovative groundwater remediation technology to address the contamination at SWMU 2C. A draft-final work plan was submitted to the EPA in March 1998 that defined sampling tasks and field investigation procedures for performing for an Oxygen Release Compound (ORC) pilot study. This draft-final document, dated March, 1998, is currently being reviewed by the EPA. In addition, the Air Force is looking for pilot study SWMU for an innovative groundwater remediation technology it is developing. SWMU 2C is being considered by Air Force as a potential study SWMU for this remediation technology, Reductive Anaerobic Biological In-Situ Treat Technology (RABITT).

In pursuit of determining the applicability of an innovative groundwater remediation technology at SWMU 2C, a direct push technology (DPT) groundwater investigation to further delineate contamination "hot spots" defined by the July 1999 groundwater sampling event. The work plan for this investigation, *Work Plan Addendum, Direct Push Technology Investigation, Supplemental Activities, SWMU 2C,* December 1999, will be implemented in February 2000.

A.3 SWMU 2E - Line Shack 109 Disposal Area

SWMU 2E is the area bounded by Hangar 23, Line Shack 109, Building 110, and a steam line along First Street. Because Line Shack 109 was constructed in 1963, it has been used for aircraft cleaning and maintenance, and equipment and material storage. The IAS identified this unit as a location where waste chemicals from the Navy's cleaning and maintenance activities were disposed (RGH, 1984). These wastes potentially include oil, PD 680, aromatic hydrocarbons, and hydraulic fluid (RGH, 1984). There was reported to be a POL disposal area on the ground behind Line Shack 109 along the flight line fence (RGH, 1984).

At the time of the IAS, a waste oil bowser and hazardous waste drums were seen on the ground along the fence (RGH, 1984). Waste oil also was reportedly funneled into a manhole near Line Shack 109 (RGH, 1984). This practice damaged electrical circuits that were encased in the manhole and prompted a cleanup of the manhole. This manhole is between Line Shack 109 and Hanger 23 near the northwest corner of Line Shack 109. A temporary hazardous waste storage area was constructed next to the fence near Hangar 23 between 1984 and 1988.

A.3.1 Investigation Status

The IAS identified the SWMU 2E area as a waste disposal area. After the RFA, the area was designated as SWMU 51 and SWMU 1. During the interim RI in 1990 the areas were investigated together and were merged to become SWMU 2E. Low concentrations of VOCs were detected in groundwater and floating free-phase product identified as diesel fuel was discovered. Subsequent investigations of SWMU 2E were focused on the characterization and extent of free-phase product. The Navy instituted a program of product recovery which involved trenching to determine the areal extent of the product and bailing product from wells.

SWMU 2E was investigated during two phases of the RFI. Phase I was completed in 1993 and Phase II was completed in 1995. The purpose of the RFIs were to delineate the source area and the extent of subsurface free product and to determine the nature and extent of the dissolved-phase groundwater contaminant plume. Results of the RFIs are documented in the *RCRA Facility Investigation Final Report – Phase I, Naval Air Station Oceana, Virginia Beach, Virginia,* December 1993 and the *RCRA Facility Investigation Report – Phase II, Naval Air Station Oceana, Virginia Beach, Virginia,* February 1985.

In 1995 CH2M HILL conducted a CMS to further delineate the areal and vertical extent of the dissolved-phase groundwater contaminant plume. Results are documented in the *Final Corrective Measures Study for SWMUs 2E, 15, and 24, Oceana Naval Air Station, Virginia Beach, Virginia,* March 1996.

Results of the investigations indicated that soil around the source area (Building 109) is contaminated with petroleum products as evidenced by elevated concentrations of TPH and PAHs. Several BTEX and TPH compounds were detected in surface and subsurface soil samples. Groundwater contamination at SWMU 2E consists of free product floating on the water table and dissolved-phase product in the shallow aquifer. Free product, identified as diesel fuel is found in wells near Building 109 at a thickness in the aquifer of less than ¼ inch. The dissolved-phase contamination consists of volatile and semivolatile petroleum compounds and chlorinated VOCs. The petroleum contamination is primarily BTEX and diesel-related compounds and the chlorinated VOC contamination is composed primarily of vinyl chloride and 1,2-dichloroethylene.

In the CMS, the evaluation of remedial alternatives resulted in the recommendation of the following remedial action:

- Groundwater contaminant plume containment and source-area extraction with groundwater treatment using air stripping
- Pilot testing of innovative technologies for remediation of chlorinated VOC-contaminated groundwater
- Bioremediation through injection of air and nutrients.

Cost evaluation of a source extraction and treatment system and a failed "bio-slupping" pilot test have lead the Navy to pursue additional investigation into emerging innovative groundwater remediation technologies for SWMU 2E.

A.3.2 Current Status

The Navy is planning a HHRA for SWMU 2E which will be conducted following the assumptions and protocol as agreed upon with the EPA. Following the risk assessments the Navy will proceed with a focused FS, a PRAP, and a ROD for SWMU 2E.

Attachment B

Interim Deliverable Table 1

TABLE 1a

SELECTION OF EXPOSURE PATHWAYS

SWMU 2B at NAS Oceana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Groundwater	Groundwater	Columbia Aquifer - Tap Water	Industrial Worker	Adult	Dermal Absorption	On-site	None	Pathway incomplete - groundwater not currently used on site as a water supply and alternative water supplies available.
						Ingestion	On-site	None	Pathway incomplete - groundwater not currently used on site as a water supply and alternative water supplies available.
	Surface Soil	Surface Soil	Unpaved areas adjacent to Line Shacks 130 -131	Industrial Worker	Adult	Dermal Absorption	On-site	Quant	Site workers could contact soil while conducting maintenance activities.
						Ingestion	On-site	Quant	Site workers could contact soil while conducting maintenance activities.
				Trespasser/Visitor	Adult	Dermal Absorption	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
						Ingestion	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
					Adolescents	Dermal Absorption	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
						Ingestion	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
		Air	Outdoor areas adjacent to Line Shacks 130 -131	Industrial Worker	Adult	Inhalation	On-site	Quant	Site workers may inhale vapors and dust emanating from soil.
				Trespasser/Visitor	Adult	Inhalation	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
					Adolescents	Inhalation	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
Current/Future	Surface Water	Surface Water	Drainage channel outside fenced/secured area	Trespasser/Visitor	Adult	Dermal Absorption	On-site	Quant	Drainage channel extends outside of fenced area and could be used for wading.
						Ingestion	On-site	Quant	Drainage channel extends outside of fenced area and could be used for wading.
					Adolescents	Dermal Absorption	On-site	Quant	Drainage channel extends outside of fenced area and could be used for wading.
						Ingestion	On-site	Quant	Drainage channel extends outside of fenced area and could be used for wading.
				Industrial Worker	Adult	Dermal Absorption	On-site	Quant	Drainage channel is periodically maintained.
						Ingestion	On-site	Quant	Drainage channel extends outside of fenced area and could be used for wading.
		Animal Tissue	Fish from drainage channel outside fenced/secured area	Fisher	Adult	Ingestion	On-site	None	Pathway incomplete - fishing does not occur in the drainage channel.
	Sediment	Sediment	Drainage channel outside fenced/secured area	Trespasser/Visitor	Adult	Dermal Absorption	On-site	Quant	Drainage channel extends outside of fenced area and could be used for wading.
						Ingestion	On-site	Quant	Drainage channel extends outside of fenced area and could be used for wading.
					Adolescents	Dermal Absorption	On-site	Quant	Drainage channel extends outside of fenced area and could be used for wading.
						Ingestion	On-site	Quant	Drainage channel extends outside of fenced area and could be used for wading.
Current/Future	Sediment	Sediment	Drainage channel outside fenced/secured area	Industrial Worker	Adult	Dermal Absorption	On-site	Quant	Drainage channel is periodically maintained.
						Ingestion	On-site	Quant	Drainage channel is periodically maintained.

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SELECTION OF EXPOSURE PATHWAYS

SWMU 2B at NAS Oceana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Columbia Aquifer - Tap Water	Resident**	Adult	Dermal Absorption	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
						Ingestion	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
					Child	Dermal Absorption	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
						Ingestion	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
					Adult/Child	Dermal Absorption	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
						Ingestion	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
			Columbia Aquifer - Water in Excavation Trench	Construction Worker	Adult	Dermal Absorption	On-site	Quant	Construction worker may contact shallow groundwater during construction activities.
						Ingestion	On-site	None	Pathway incomplete - construction worker not expected to incidentally ingest significant amount of groundwater during construction activities.
		Air	Columbia Aquifer -Water Vapors at Showerhead	Resident	Adult	Inhalation	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
					Child	Inhalation	On-site	None	Pathway incomplete - children are assumed to bathe, not to shower.
			Columbia Aquifer - Volatilization from Water in Excavation Trench	Construction Worker	Adult	Inhalation	On-site	Quant	Construction worker may inhale vapors from shallow groundwater during construction activities.
	Soil*	Soil*	Yards of homes constructed within SWMU	Resident**	Adult	Dermal Absorption	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
						Ingestion	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
					Child	Dermal Absorption	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
						Ingestion	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
					Adult/Child	Dermal Absorption	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
						Ingestion	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
			Areas within SWMU that may be developed	Construction Worker	Adult	Dermal Absorption	On-site	Quant	Exposure to soil could occur during construction activities.
						Ingestion	On-site	Quant	Exposure to soil could occur during construction activities.

TABLE 1a

SELECTION OF EXPOSURE PATHWAYS

SWMU 2B at NAS Oceana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Soil*	Soil*	Unpaved areas within SWMU	Industrial Worker	Adult	Dermal Absorption	On-site	Quant	Site workers could contact soil while conducting maintenance activities.
						Ingestion	On-site	Quant	Site workers could contact soil while conducting maintenance activities.
				Trespasser/Visitor	Adult	Dermal Absorption	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
						Ingestion	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
					Adolescents	Dermal Absorption	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
						Ingestion	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
		Air	Yards of homes constructed within SWMU	Resident**	Adult	Inhalation	On-site	Quant	Residents may inhale vapors and dust from soil, if the site is used for future residential development.
					Child	Inhalation	On-site	Quant	Residents may inhale vapors and dust from soil, if the site is used for future residential development.
					Adult/Child	Inhalation	On-site	Quant	Residents may inhale vapors and dust from soil, if the site is used for future residential development.
			Areas within SWMU that may be developed	Construction Worker	Adult	Inhalation	On-site	Quant	Workers could inhale vapors or particulates during construction activities.
			Unpaved areas within SWMU	Industrial Worker	Adult	Inhalation	On-site	Quant	Site workers may inhale vapors and dust from soil while performing routine duties.
				Trespasser/Visitor	Adult	Inhalation	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
					Adolescents	Inhalation	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.

* Assumes subsurface soil could be excavated and spread over surface of site during development.

** Noncarcinogenic hazard evaluated separately for adult and child receptors, combined lifetime carcinogenic risk evaluated on an age-adjusted basis for residential scenario.

SELECTION OF EXPOSURE PATHWAYS

SWMU 2C at NAS Oceana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Groundwater	Groundwater	Columbia Aquifer - Tap Water	Industrial Worker	Adult	Dermal Absorption	On-site	None	Pathway incomplete - groundwater not currently used on site as a water supply and alternative water supplies available.
						Ingestion	On-site	None	Pathway incomplete - groundwater not currently used on site as a water supply and alternative water supplies available.
	Surface Soil	Surface Soil	Unpaved areas adjacent to Line Shacks and Hangers	Industrial Worker	Adult	Dermal Absorption	On-site	Quant	Site workers could contact soil while conducting maintenance activities.
						Ingestion	On-site	Quant	Site workers could contact soil while conducting maintenance activities.
				Trespasser/Visitor	Adult	Dermal Absorption	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
						Ingestion	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
					Adolescents	Dermal Absorption	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
						Ingestion	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
		Air	Outdoor areas adjacent to Line Shacks and Hangers	Industrial Worker	Adult	Inhalation	On-site	Quant	Site workers may inhale vapors and dust emanating from soil.
				Trespasser/Visitor	Adult	Inhalation	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
					Adolescents	Inhalation	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
Future	Groundwater	Groundwater	Columbia Aquifer - Tap Water	Resident**	Adult	Dermal Absorption	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
						Ingestion	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
					Child	Dermal Absorption	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
						Ingestion	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
					Adult/Child	Dermal Absorption	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
						Ingestion	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
			Columbia Aquifer - Water in Excavation Trench	Construction Worker	Adult	Dermal Absorption	On-site	Quant	Construction worker may contact shallow groundwater during construction activities.
						Ingestion	On-site	None	Pathway incomplete - construction worker not expected to incidentally ingest significant amount of groundwater during construction activities.

TABLE 1b

SELECTION OF EXPOSURE PATHWAYS

SWMU 2C at NAS Oceana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Air	Columbia Aquifer -Water Vapors at Showerhead	Resident	Adult	Inhalation	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
					Child	Inhalation	On-site	None	Pathway incomplete - children are assumed to bathe, not to shower.
			Columbia Aquifer - Volatilization from Water in Excavation Trench	Construction Worker	Adult	Inhalation	On-site	Quant	Construction worker may inhale vapors from shallow groundwater during construction activities.
	Soil*	Soil*	Yards of homes constructed within SWMU	Resident**	Adult	Dermal Absorption	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
						Ingestion	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
					Child	Dermal Absorption	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
						Ingestion	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
					Adult/Child	Dermal Absorption	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
						Ingestion	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
			Areas within SWMU that may be developed	Construction Worker	Adult	Dermal Absorption	On-site	Quant	Exposure to soil could occur during construction activities.
						Ingestion	On-site	Quant	Exposure to soil could occur during construction activities.
			Unpaved areas within SWMU	Industrial Worker	Adult	Dermal Absorption	On-site	Quant	Site workers could contact soil while conducting maintenance activities.
						Ingestion	On-site	Quant	Site workers could contact soil while conducting maintenance activities.
				Trespasser/Visitor	Adult	Dermal Absorption	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
						Ingestion	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
					Adolescents	Dermal Absorption	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
						Ingestion	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.

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SELECTION OF EXPOSURE PATHWAYS

SWMU 2C at NAS Oceana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Soil*	Air	Yards of homes constructed within SWMU	Resident**	Adult	Inhalation	On-site	Quant	Residents may inhale vapors and dust from soil, if the site is used for future residential development.
					Child	*Inhalation*	*On-site*	*Quant*	Residents may inhale vapors and dust from soil, if the site is used for future residential development.
					Adult/Child	Inhalation	On-site	Quant	Residents may inhale vapors and dust from soil, if the site is used for future residential development.
			Areas within SWMU that may be developed	Construction Worker	Adult	Inhalation	On-site	Quant	Workers could inhale vapors or particulates during construction activities.
			Unpaved areas within SWMU	*Industrial Worker*	*Adult*	*Inhalation*	*On-site*	*Quant*	Site workers may inhale vapors and dust from soil while performing routine duties.
				Trespasser/Visitor	Adult	Inhalation	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
					Adolescents	Inhalation	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.

** Assumes subsurface soil could be excavated and spread over surface of site during development.*

** Noncarcinogenic hazard evaluated separately for adult and child receptors, combined lifetime carcinogenic risk evaluated on an age-adjusted basis for residential scenario.

TABLE 1c

SELECTION OF EXPOSURE PATHWAYS

SWMU 2E at NAS Oceana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Groundwater	Groundwater	Columbia Aquifer - Tap Water	Industrial Worker	Adult	Dermal Absorption	On-site	None	Pathway incomplete - groundwater not currently used on site as a water supply and alternative water supplies available.
						Ingestion	On-site	None	Pathway incomplete - groundwater not currently used on site as a water supply and alternative water supplies available.
	Surface Soil	Surface Soil	Unpaved areas adjacent to Line Shacks and Hangers	Industrial Worker	Adult	Dermal Absorption	On-site	Quant	Site workers could contact soil while conducting maintenance activities.
						Ingestion	On-site	Quant	Site workers could contact soil while conducting maintenance activities.
				Trespasser/Visitor	Adult	Dermal Absorption	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
						Ingestion	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
					Adolescents	Dermal Absorption	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
						Ingestion	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
		Air	Outdoor areas adjacent to Line Shacks and Hangers	Industrial Worker	Adult	Inhalation	On-site	Quant	Site workers may inhale vapors and dust emanating from soil.
				Trespasser/Visitor	Adult	Inhalation	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
					Adolescents	Inhalation	On-site	None	Pathway incomplete - site is fenced, secured, and heavily used along the Flight Line, therefore, trespassers are not anticipated on the site.
Future	Groundwater	Groundwater	Columbia Aquifer - Tap Water	Resident**	Adult	Dermal Absorption	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
						Ingestion	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
					Child	Dermal Absorption	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
						Ingestion	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
					Adult/Child	Dermal Absorption	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
						Ingestion	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
			Columbia Aquifer - Water in Excavation Trench	Construction Worker	Adult	Dermal Absorption	On-site	Quant	Construction worker may contact shallow groundwater during construction activities.
						Ingestion	On-site	None	Pathway iIncomplete - construction worker not expected to incidentally ingest significant amount of groundwater during construction activities.

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SELECTION OF EXPOSURE PATHWAYS

SWMU 2E at NAS Oceana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Air	Columbia Aquifer -Water Vapors at Showerhead	Resident	Adult	Inhalation	On-site	Quant	Although unlikely, shallow groundwater could be used as a potable water supply in the future.
					Child	Inhalation	On-site	None	Pathway incomplete - children are assumed to bathe, not to shower.
			Columbia Aquifer - Volatilization from Water in Excavation Trench	Construction Worker	Adult	Inhalation	On-site	Quant	Construction worker may inhale vapors from shallow groundwater during construction activities.
	Soil*	Soil*	Yards of homes constructed within SWMU	Resident**	Adult	Dermal Absorption	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
						Ingestion	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
					Child	Dermal Absorption	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
						Ingestion	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
					Adult/Child	Dermal Absorption	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
						Ingestion	On-site	Quant	Residents may contact surface soil, if the site is used for future residential development.
			Areas within SWMU that may be developed Unpaved areas within SWMU	Construction Worker	Adult	Dermal Absorption	On-site	Quant	Exposure to soil could occur during construction activities.
						Ingestion	On-site	Quant	Exposure to soil could occur during construction activities.
				Industrial Worker	Adult	Dermal Absorption	On-site	Quant	Site workers could contact soil while conducting maintenance activities.
						Ingestion	On-site	Quant	Site workers could contact soil while conducting maintenance activities.
				Trespasser/Visitor	Adult	Dermal Absorption	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
						Ingestion	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
					Adolescents	Dermal Absorption	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
						Ingestion	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.

TABLE 1c

SELECTION OF EXPOSURE PATHWAYS

SWMU 2E at NAS Oceana

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Soil*	Air	Yards of homes constructed within SWMU	Resident**	Adult	Inhalation	On-site	Quant	Residents may inhale vapors and dust from soil, if the site is used for future residential development.
					Child	Inhalation	On-site	Quant	Residents may inhale vapors and dust from soil, if the site is used for future residential development.
					Adult/Child	Inhalation	On-site	Quant	Residents may inhale vapors and dust from soil, if the site is used for future residential development.
			Areas within SWMU that may be developed	Construction Worker	Adult	Inhalation	On-site	Quant	Workers could inhale vapors or particulates during construction activities.
			Unpaved areas within SWMU	Industrial Worker	Adult	Inhalation	On-site	Quant	Site workers may inhale vapors and dust from soil while performing routine duties.
				Trespasser/Visitor	Adult	Inhalation	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.
					Adolescents	Inhalation	On-site	Quant	Future restrictions to site access unknown, therefore trepassing assumed to be possible.

* Assumes subsurface soil could be excavated and spread over surface of site during development.

** Noncarcinogenic hazard evaluated separately for adult and child receptors, combined lifetime carcinogenic risk evaluated on an age-adjusted basis for residential scenario.

Attachment C

Interim Deliverable Table 4

TABLE 4.1

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Unpaved areas adjacent to Line Shacks 130-131
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	see Table ----	--	see Table ----	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	EPA, 1991	50	EPA, 1993	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	250	EPA, 1991	219	EPA, 1993	
	ED	Exposure Duration	years	25	EPA, 1991	5	EPA, 1993	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	EPA, 1989	1,825	EPA, 1989	
Dermal Absorption	CS	Chemical Concentration in Soil	mg/kg	see Table ----	--	see Table ----	--	CDI (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm^2	5,800	EPA, 1992	5,000	EPA, 1992	CS x SA x SSAF x DABS x CF3 x EF x
	SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.32	EPA, 1997	0.32	EPA, 1997	ED x 1/BW x 1/AT
	DABS	Dermal Absorption Factor Solids	--	chem specific	EPA, 1995	chem specific	EPA, 1995	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	EF	Exposure Frequency	days/year	250	EPA, 1991	219	EPA, 1993	
	ED	Exposure Duration	years	25	EPA, 1991	5	EPA, 1993	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	EPA, 1989	1,825	EPA, 1989	

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa; SSAF based on maximum adherence factor for utility workers.

DABS: Based on Region III Technical Guidance "Assessing Dermal Exposure from Soil, December 1995", for constituents not listed used volatile organics value of 20%, semi-volatile organics value of 10%, and inorganics value of 1%.

SA: Based on 25% of total body surface area for adult or 25% of 23,000 cm^2 for RME and 25% of 20,000 cm^2 for CT.

TABLE 4.2

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Outdoor areas adjacent to Line Shacks 130-131
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	see Table ----	- -	see Table ---	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
	CA	Chemical Concentration in Air	mg/m^3	see Table ----	- -	see Table ---	- -	CA x IN x ET x EF x ED x 1/BW x 1/AT
	PEF	Particulate Emissions Factor	m^3/kg	1.32E+09	EPA, 1996	1.32E+09	EPA, 1996	
	VF	Volatilization Factor for volatile constituents	m^3/kg	chem specific	EPA, 1996	chem specific	EPA, 1996	
	IN	Inhalation Rate	m^3/hour	0.83	EPA, 1999	0.83	EPA, 1999	
	ET	Exposure Time	hr/day	8	(1)	4	(1)	CA (mg/m^3) = CS (1/PEF+ 1/VF)
	EF	Exposure Frequency	days/year	250	EPA,1991	219	EPA, 1993	
	ED	Exposure Duration	years	25	EPA, 1991	5	EPA., 1993	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	EPA, 1989	1,825	EPA, 1989	

(1) Professional Judgement based on maintenance activities that would occur 8 hrs per day for the RME and 1/2 of a day for the CT.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.

EPA, 1999: Region III Risk-Based Concentration Table. October 27, 1999.

TABLE 4.3

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Drainage channel outside fenced/secured area
Receptor Population: Trespasser/Visitor
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical Concentration in Surface Water	µg/l	see Table ----	--	see Table ----	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-SW	Ingestion Rate of Surface Water	l/hour	0.08	EPA, 1989	0.08	(2)	CSW x IR-SW x ET x EF x ED x CF1 x
	ET	Exposure Time	hr/day	2.6	EPA, 1989	2.6	(2)	1/BW x 1/AT
	EF	Exposure Frequency	days/year	52	(1)	26	(1)	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	
	CF1	Conversion Factor 1	mg/µg	0.001	--	0.001	--	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	
Dermal Absorption	CSW	Chemical Concentration in Surface Water	µg/l	see Table ----	--	see Table ----	--	CDI (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm^2	6,000	EPA, 1997	5,100	EPA, 1997	CSW x SA x PC x CF1 x ET x EF x ED x
	PC	Permeability Constant	cm/hr	chem specific	EPA, 1992	chem specific	EPA, 1992	CF2 x 1/BW x 1/AT
	CF1	Conversion Factor 1	mg/µg	0.001	--	0.001	--	
	ET	Exposure Time	hr/day	2.6	EPA, 1989	2.6	(2)	
	EF	Exposure Frequency	days/year	52	(1)	26	(1)	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	
	CF2	Conversion Factor 2	l/cm^3	0.001	--	0.001	--	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	

(1) Professional Judgement assuming 1 day per week for 52 weeks per year for the RME and 1/2 the RME value for the CT.

(2) Not available, used RME value.

Sources:

EPA, 1989. Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

TABLE 4.3

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Drainage channel outside fenced/secured area
Receptor Population: Trespasser/Visitor
Receptor Age: Adult

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

SA: Skin surface area in contact with surface water based on contact while wading. It is assumed that 30% of the total surface area of 20,000 cm^2 for the RME and 30% of the 17,000 cm^2 for the CT would contact the surface water.

TABLE 4.4

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Drainage channel outside fenced/secured area
Receptor Population: Trespasser/Visitor
Receptor Age: Adolescents

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical Concentration in Surface Water	µg/l	see Table ----	--	see Table ----	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-SW	Ingestion Rate of Surface Water	l/hour	0.08	EPA, 1989	0.08	(2)	CSW x IR-SW x ET x EF x ED x CF1 x
	ET	Exposure Time	hr/day	2.6	EPA, 1989	2.6	(2)	1/BW x 1/AT
	EF	Exposure Frequency	days/year	52	(1)	26	(1)	
	ED	Exposure Duration	years	9	(3)	9	EPA, 1993	
	CF1	Conversion Factor 1	mg/µg	0.001	--	0.001	--	
	BW	Body Weight	kg	51	EPA, 1997,(3)	51	EPA, 1997,(3)	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,285	EPA, 1989	3,285	EPA, 1989	
Dermal Absorption	CSW	Chemical Concentration in Surface Water	µg/l	see Table ----	--	see Table ----	--	CDI (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm^2	7,780	EPA, 1997	4,160	EPA, 1997	CSW x SA x PC x CF1 x ET x EF x ED x
	PC	Permeability Constant	cm/hr	chem specific	EPA, 1992	chem specific	EPA, 1992	CF2 x 1/BW x 1/AT
	CF1	Conversion Factor 1	mg/µg	0.001	--	0.001	--	
	ET	Exposure Time	hr/day	2.6	EPA, 1989	2.6	(2)	
	EF	Exposure Frequency	days/year	52	(1)	26	(1)	
	ED	Exposure Duration	years	9	(3)	9	EPA, 1993	
	CF2	Conversion Factor 2	l/cm^3	0.001	--	0.001	--	
	BW	Body Weight	kg	51	EPA, 1997, (3)	51	EPA, 1997, (3)	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,285	EPA, 1989	3,285	EPA, 1989	

TABLE 4-4

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Drainage channel outside fenced/secured area
Receptor Population: Trespasser/Visitor
Receptor Age: Adolescents

(1) Professional Judgement assuming 1 day per week for 52 weeks per year for the RME and 1/2 the RME value for the CT.

(2) Not available, used RME value.

(3) Body weight is average value for the 9 year old and 18 year old male body weight.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

SA: Surface area based on 43.2% of the 50th percentile total body surface area for the male child aged 17-18 years for the RME. The CT is based on 41.6% of the 50th percentile total body surface area for the male child age 9 - 10 years. These percentages correspond to the mean values for hands and lower extremeties for each age group. (Tables 6-6 and 6-8 of EPA, 1997).

TABLE 4.5

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Drainage channel outside fenced/secured area
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical Concentration in Surface Water	µg/l	see Table ----	--	see Table ----	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-SW	Ingestion Rate of Surface Water	l/hour	0.08	EPA, 1989	0.08	(2)	CSW x IR-SW x ET x EF x ED x CF1 x
	ET	Exposure Time	hr/day	8	(1)	4	(1)	1/BW x 1/AT
	EF	Exposure Frequency	days/year	10	(2)	5	(2)	
	ED	Exposure Duration	years	25	EPA, 1991	5	EPA, 1993	
	CF1	Conversion Factor 1	mg/µg	0.001	--	0.001	--	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	EPA, 1989	1,825	EPA, 1989	
Dermal Absorption	CSW	Chemical Concentration in Surface Water	mg/kg	see Table ----	--	see Table ----	--	CDI (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm^2	6,000	EPA, 1997	5,100	EPA, 1997	CSW x SA x PC x CF1 x ET x EF x ED x
	PC	Permeability Constant	cm/hr	chem specific	EPA, 1992	chem specific	EPA, 1992	CF2 x 1/BW x 1/AT
	CF1	Conversion Factor 1	mg/µg	0.001	--	0.001	--	
	ET	Exposure Time	hr/day	8	(1)	4	(1)	
	EF	Exposure Frequency	days/year	10	(2)	5	(2)	
	ED	Exposure Duration	years	25	EPA, 1991	5	EPA, 1993	
	CF2	Conversion Factor 2	l/cm^3	0.001	--	0.001	--	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	EPA, 1989	1,825	EPA, 1989	

TABLE 4.5

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Drainage channel outside fenced/secured area
Receptor Population: Industrial Worker
Receptor Age: Adult

(1) Professional Judgement based on maintenance activities that would occur 8 hrs per day for the RME and 1/2 of a day for the CT.

(2) Professional Judgement based on maintenance activities that would occur 10 days per year (2 weeks) for the RME and 5 days per year (1 week) for the CT.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03

EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa; SSAF based on maximum adherence factor for utility workers.

SA: Skin surface area in contact with surface water based on contact while wading. It is assumed that 30% of the total surface area of 20,000 cm^2 for the RME and 30% of the 17,000 cm^2 for the CT would contact the surface water.

TABLE 4.6

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Drainage channel outside fenced/secured area
Receptor Population: Trespasser/Visitor
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSed	Chemical Concentration in Sediment	mg/kg	see Table ----		see Table ----	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-Sed	Ingestion Rate of Sediment	mg/day	100	EPA, 1991	50	EPA, 1993	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	52	(1)	26	(1)	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	
	CF3	Conversion Factor 3	kg/mg	0.000001	- -	0.000001	- -	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	
Dermal Absorption	CSed	Chemical Concentration in Sediment	mg/kg	see Table ----	- -	see Table ----	- -	CDI (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm^2	6,000	EPA, 1997	5,100	EPA, 1997	CSed x SA x SSAF x DABS x CF3 x EF x
	SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.32	EPA, 1992	0.32	EPA, 1992	ED x 1/BW x 1/AT
	DABS	Dermal Absorption Factor Solids	--	chem specific	EPA, 1995	chem specific	EPA, 1995	
	CF3	Conversion Factor 3	kg/mg	0.000001	- -	0.000001	- -	
	EF	Exposure Frequency	days/year	52	(1)	26	(1)	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	

TABLE 4.6

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Drainage channel outside fenced/secured area
Receptor Population: Trespasser/Visitor
Receptor Age: Adult

(1) Professional Judgement assuming 1 day per week for 52 weeks per year for the RME and 1/2 the RME value for the CT.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

DABS: Based on Region III Technical Guidance "Assessing Dermal Exposure from Soil, December 1995", for constituents not listed used volatile organics value of 20%, semi-volatile organics value of 10%, and inorganics value of 1%.

SA: Skin surface area in contact with sediment based on contact while wading. It is assumed that 30% of the total surface area of 20,000 cm^2 for the RME and 30% of the 17,000 cm^2 for the CT would contact the sediment.

TABLE 4.7

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Drainage channel outside fenced/secured area
Receptor Population: Trespasser/Visitor
Receptor Age: Adolescents

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSed	Chemical Concentration in Sediment	mg/kg	see Table ----		see Table ----	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-Sed	Ingestion Rate of Sediment	mg/day	100	EPA, 1991	50	EPA, 1993	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	52	(1)	26	(1)	
	ED	Exposure Duration	years	9	(2)	9	EPA, 1993	
	CF3	Conversion Factor 3	kg/mg	0.000001	- -	0.000001	- -	
	BW	Body Weight	kg	51	EPA, 1997,(3)	51	EPA, 1997,(3)	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,285	EPA, 1989	3,285	EPA, 1989	
Dermal Absorption	CSed	Chemical Concentration in Sediment	mg/kg	see Table ----	- -	see Table ----	- -	CDI (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm^2	4,375	EPA, 1997	3,351	EPA, 1997	CSed x SA x SSAF x DABS x CF3 x EF x
	SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.11	EPA, 1997	0.11	EPA, 1997	ED x 1/BW x 1/AT
	DABS	Dermal Absorption Factor Solids	--	chem specific	EPA, 1995	chem specific	EPA, 1995	
	CF3	Conversion Factor 3	kg/mg	0.000001	- -	0.000001	- -	
	EF	Exposure Frequency	days/year	52	(1)	26	(1)	
	ED	Exposure Duration	years	9	(2)	9	EPA, 1993	
	BW	Body Weight	kg	51	EPA, 1997, (3)	51	EPA, 1997, (3)	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,285	EPA, 1989	3,285	EPA, 1989	

TABLE 4.7

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Drainage channel outside fenced/secured area
Receptor Population: Trespasser/Visitor
Receptor Age: Adolescents

(1) Professional Judgement assuming 1 day per week for 52 weeks per year for the RME and 1/2 the RME value for the CT.

(2) Professional Judgement assuming adolescents from 9 to 18 years of age.

(3) Body weight is average value for the 9 year old and 18 year old mean male body weight.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

DABS: Based on Region III Technical Guidance "Assessing Dermal Exposure from Soil, December 1995", for constituents not listed used volatile organics value of 20%, semi-volatile organics value of 10%, and Inorganics value of 1%.

SA: Surface area based on 25% of total body surface area for the male child aged 15-18 years for the RME. The CT is based on 25% of the average surface area between the 9-12 years and 15-18 year old male child. (Table 6-6 of EPA, 1997).

TABLE 4.8

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Drainage channel outside fenced/secured area
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSed	Chemical Concentration in Sediment	mg/kg	see Table ----		see Table ----	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-Sed	Ingestion Rate of Sediment	mg/day	100	EPA, 1991	50	EPA, 1993	CSed x IR-Sed x EF x ED x CF3 x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	10	(1)	5	(1)	
	ED	Exposure Duration	years	25	EPA, 1991	5	EPA, 1993	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	EPA, 1989	1,825	EPA, 1989	
Dermal Absorption	CSed	Chemical Concentration in Sediment	mg/Kg	see Table ----	--	see Table ----	--	CDI (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm^2	6,000	EPA, 1997	5,100	EPA, 1997	CSed x SA x SSAF x DABS x CF3 x EF x
	SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.32	EPA, 1997	0.32	EPA, 1997	ED x 1/BW x 1/AT
	DABS	Dermal Absorption Factor Solids	--	chem specific	EPA, 1995	chem specific	EPA, 1995	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	EF	Exposure Frequency	days/year	10	(1)	5	(1)	
	ED	Exposure Duration	years	25	EPA, 1991	5	EPA, 1993	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	EPA, 1989	1,825	EPA, 1989	

TABLE 4.8

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Drainage channel outside fenced/secured area
Receptor Population: Industrial Worker
Receptor Age: Adult

(1) Professional Judgement based on maintenance activities that would occur 10 days per year (2 weeks) for the RME and 5 days per year (1 week) for the CT.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

DABS: Based on Region III Technical Guidance "Assessing Dermal Exposure from Soil, December 1995", for constituents not listed used volatile organics value of 20%, semi-volatile organics value of 10%, and Inorganics value of 1%.

SA: Skin surface area in contact with sediment based on contact while wading. It is assumed that 30% of the total surface area of 20,000 cm^2 for the RME and 30% of the 17,000 cm^2 for the CT would contact the sediment.

TABLE 4.9

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Columbia Aquifer - Tap Water
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CW	Chemical Concentration in Water	µg/l	see Table ----	- -	see Table ----	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-W	Ingestion Rate of Water	liters/day	2	EPA, 1997	1.4	EPA, 1993	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	
	CF1	Conversion Factor 1	mg/µg	0.001	- -	0.001	- -	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	
Dermal Absorption	CW	Chemical Concentration in Water	µg/l	see Table ----		see Table ----	chem specific	CDI (mg/kg-day) =
	DAevent	Dermally Absorbed Dose per Event	mg/cm^2-event	calculated	EPA, 1992	calculated	EPA, 1992	DAevent x SA x EF x ED x 1/BW x 1/AT
	CF1	Conversion Factor 1	mg/µg	0.001	- -	0.001	- -	
	PC	Permeability Constant	cm/hr	chem specific	EPA, 1992	chem specific	EPA, 1992	Inorganics: DAevent (mg/cm^2-event) =
	t	Lag Time	hours	chem specific	EPA, 1992	chem specific	EPA, 1992	PC x CW x ET x CF1 x CF2
	B	Ratio of Permeability of Stratum Corneum to Epidermis	dimensionless	chem specific	EPA, 1992	chem specific	EPA, 1992	
	t*	Time to reach equilibrium	hours	chem specific	EPA, 1992	chem specific	EPA, 1992	Organics :
	ET	Exposure Time	hr/day	0.2	EPA, 1995	0.2	(1)	ET<t*: DAevent (mg/cm^2-event) =
	CF2	Conversion Factor 2	l/cm^3	0.001	- -	0.001	- -	2 x PC x CW x (sqrt((6 x t x ET)/3.1415))
	SA	Skin Surface Area Available for Contact	cm^2	20,000	EPA, 1992	17,000	EPA, 1992	x CF1 x CF2
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	ET>t*: DAevent (mg/cm^2-event) =
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	PC x CW x (ET/(1+B) + 2 x t x ((1 + 3xB)/(1+B))
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	x CF1 x CF2

TABLE 4.9

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Columbia Aquifer - Tap Water
Receptor Population: Resident
Receptor Age: Adult

(1) Not available, used RME value.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

SA: Skin surface area in contact with groundwater are based on ranges. For total adult male, surface area ranges from 17,000 to 23,000 cm ^{2}, with a mean of 20,000 cm^2; the mean value of 20,000 cm^2 is used for the RME value and 17,000 cm^2 is used for the CT value.

TABLE 4.10

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Columbia Aquifer - Tap Water
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CW	Chemical Concentration in Water	µg/l	see Table ---	- -	see Table ---	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-W	Ingestion Rate of Water	liters/day	1	EPA, 1997	1	(1)	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	
	ED	Exposure Duration	years	6	EPA, 1991	6	(1)	
	CF1	Conversion Factor 1	mg/µg	0.001	- -	0.001	- -	
	BW	Body Weight	kg	15	EPA, 1991	15	EPA, 1991	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	EPA, 1989	2,190	EPA, 1989	
Dermal Absorption	CW	Chemical Concentration in Water	µg/l	see Table ---		see Table ---	chem specific	CDI (mg/kg-day) =
	DAevent	Dermally Absorbed Dose per Event	mg/cm^2-event	calculated	EPA, 1992	calculated	EPA, 1992	DAevent x SA x EF x ED x 1/BW x 1/AT
	CF1	Conversion Factor 1	mg/µg	0.001	- -	0.001	- -	
	PC	Permeability Constant	cm/hr	chem specific	EPA, 1992	chem specific	EPA, 1992	Inorganics: DAevent (mg/cm2-event) =
	t	Lag Time	hours	chem specific	EPA, 1992	chem specific	EPA, 1992	PC x CW x ET x CF1 x CF2
	B	Ratio of Permeability of Stratum Corneum to Epidermis	dimensionless	chem specific	EPA, 1992	chem specific	EPA, 1992	
	t*	Time to reach equilibrium	hours	chem specific	EPA, 1992	chem specific	EPA, 1992	Organics :
	ET	Exposure Time	hr/day	0.33	EPA, 1992	0.33	(1)	ET<t*: DAevent (mg/cm2-event) =
	CF2	Conversion Factor 2	l/cm^3	0.001	- -	0.001	- -	2 x PC x CW x (sqrt((6 x t x ET)/3.1415))
	SA	Skin Surface Area Available for Contact	cm^2	7,930	EPA, 1992	6,980	EPA, 1992	x CF1 x CF2
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	
	ED	Exposure Duration	years	6	EPA, 1991	6	(1)	ET>t*: DAevent (mg/cm2-event) =
	BW	Body Weight	kg	15	EPA, 1991	15	EPA, 1991	PC x CW x (ET/(1+B) + 2 x t x ((1 + 3xB)/(1+B))
	AT-N	Averaging Time (Non-Cancer)	days	2,190	EPA, 1989	2,190	EPA, 1989	

TABLE ...6

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Columbia Aquifer - Tap Water
Receptor Population: Resident
Receptor Age: Child

(1) Not available, used RME value.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

SA: Skin surface area for the RME is based on the 50th percentile total surface area for the child ages 5-6 years (Table 6-6 of EPA, 1999). The CT value is based on the average between the 50th percentile surface areas for the child ages 2-3 years and 5-6 years.

TABLE 4.11

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Columbia Aquifer - Tap Water
Receptor Population: Resident
Receptor Age: Child/Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CW	Chemical Concentration in Water	µg/l	see Table ...	see Table ...	see Table ...	see Table ...	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-W-A	Ingestion Rate of Water, Adult	liters/day	2	EPA, 1997	1.4	EPA, 1993	CW x IR-W-Adj x EF x CF1 x 1/AT
	IR-W-C	Ingestion Rate of Water, Child	liters/day	1	EPA, 1997	1	EPA, 1997	
	IR-W-Adj	Ingestion Rate of Water, Age-adjusted	liter-year/kg-day	1.09	calculated	0.58	calculated	IR-W-Adj (liter-year/kd-day) =
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	(ED-C x IR-W-C / BW-C) + (ED-A x IR-W-A / BW-A)
	ED-A	Exposure Duration, Adult	years	24	EPA, 1991	9	EPA, 1993	
	ED-C	Exposure Duration, Child	years	6	EPA, 1991	6	EPA, 1991	
	CF1	Conversion Factor 1	mg/µg	0.001	- -	0.001	- -	
	BW-A	Body Weight , Adult	kg	70	EPA, 1991	70	EPA, 1991	
	BW-C	Body Weight, Child	kg	15	EPA, 1991	15	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
Absorption	CW	Chemical Concentration in Water	µg/l	see Table ...	see Table ...	see Table ...	see Table ...	CDI (mg/kg-day) =
	DAevent-A*	Dermally Absorbed Dose per Event, Adult	mg/cm^2-event	calculated	EPA, 1992	calculated	EPA, 1992	DA-Adj x EF x 1/AT-C
	DAevent-C*	Dermally Absorbed Dose per Event, Child	mg/cm^2-event	calculated	EPA, 1992	calculated	EPA, 1992	
	DA-Adj	Dermally Absorbed Dose, Age-adjusted	mg-year/event-kg	calculated	- -	calculated	- -	DA-Adj = (DAevent-A x SA-A x ED-A x 1/BW-A)
	SA-A	Skin Surface Area, Adult	cm^2	20,000	EPA, 1992	17,000	EPA, 1992	+ (DAevent-C x SA-C x ED-C x 1/BW-C)
	SA-C	Skin Surface Area, Child	cm^2	7,930	EPA, 1992	6,980	EPA, 1992	
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	
	ED-A	Exposure Duration, Adult	years	24	EPA, 1991	9	EPA, 1993	
	ED-C	Exposure Duration, Child	years	6	EPA, 1991	6	EPA, 1991	
	BW-A	Body Weight , Adult	kg	70	EPA, 1991	70	EPA, 1991	
	BW-C	Body Weight, Child	kg	15	EPA, 1991	15	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	

TABLE 4.11

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Columbia Aquifer - Tap Water
Receptor Population: Resident
Receptor Age: Child/Adult

* Equations to calculate DAevent shown in Tables 4.9 and 4.10.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

SA: Rational for skin surface areas shown in Tables 4.9 and 4.10

TABLE 4.12

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Columbia Aquifer - Water in Excavation Trench
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Dermal Absorption	CW	Chemical Concentration in Water	µg/l	see Table ----		see Table ----	chem specific	CDI (mg/kg-day) =
	DAevent	Dermally Absorbed Dose per Event	mg/cm^2-event	calculated	EPA, 1992	calculated	EPA, 1992	DAevent x SA x EF x ED x 1/BW x 1/AT
	CF1	Conversion Factor 1	mg/µg	0.001	- -	0.001	- -	
	PC	Permeability Constant	cm/hr	chem specific	EPA, 1992	chem specific	EPA, 1992	Inorganics: DAevent (mg/cm2-event) =
	t	Lag Time	hours	chem specific	EPA, 1992	chem specific	EPA, 1992	PC x CW x ET x CF1 x CF2
	B	Ratio of Permeability of Stratum Corneum to Epidermis	dimensionless	chem specific	EPA, 1992	chem specific	EPA, 1992	
	t*	Time to Reach Steady-state	hours	chem specific	EPA, 1992	chem specific	EPA, 1992	Organics :
	ET	Exposure Time	hr/day	8	(1)	4	(1)	ET<t*: DAevent (mg/cm2-event) =
	CF2	Conversion Factor 2	l/cm^3	0.001	- -	0.001	- -	2 x PC x CW x (sqrt((6 x t x ET)/3.1415))
	SA	Skin Surface Area Available for Contact	cm^2	6,000	EPA, 1997	5,100	EPA, 1997	x CF1 x CF2
	EF	Exposure Frequency	days/year	250	EPA, 1991	219	EPA, 1993	
	ED	Exposure Duration	years	1	EPA, 1991	1	EPA, 1991	ET>t*: DAevent (mg/cm2-event) =
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	PC x CW x (ET/(1+B) + 2 x t x ((1 + 3xB)/(1+B))
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	x CF1 x CF2
	AT-N	Averaging Time (Non-Cancer)	days	365	EPA, 1989	365	EPA, 1989	

TABLE 4.12

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Columbia Aquifer - Water in Excavation Trench
Receptor Population: Construction Worker
Receptor Age: Adult

(1) Professional Judgement based on construction activities that would occur 8 hrs per day for the RME and 1/2 of a day for the CT.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

SA: Skin surface area in contact with groundwater based on contact during construction activities. The total adult male surface area ranges from 17,000 to 23,000 cm^2, with a mean of 20,000 cm^2. The RME is based on 30% of the mean total adult male surface area (20,000 cm^2) or 6,000 cm^2 and the CT value is based on 30% of the 17,000 cm^2 or ,5100 cm^2.

TABLE 4.13

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air
Exposure Point: Columbia Aquifer - Water Vapors at Showerhead
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	InhExp	Inhalation Dose per Shower	mg/kg-shower	see Table ----	- -	see Table ----	- -	Foster & Chrostowski Shower Inhalation Model for InhExp
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	Chronic Daily Intake (CDI) (mg/kg-day) =
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	InhExp x EF x ED x 1/AT
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

TABLE 4.14

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air
Exposure Point: Columbia Aquifer - Volatilization from Water in Excavation Pit
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CA	Air concentration	mg/m^3	see Table --	--	see Table --	--	Two-Film Volatilization Model for CA
	IN	Inhalation Rate	m^3/hour	2.5	EPA, 1997	1.5	EPA, 1997	
	ET	Exposure Time	hr/day	8	(1)	4	(1)	Chronic Daily Intake (CDI) (mg/kg-day) =
	ED	Exposure Duration	years	1	EPA, 1991	1	(2)	CA x IN x ET x EF x ED x 1/BW x 1/AT
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	365	EPA, 1989	365	EPA, 1989	

(1) Professional Judgement based on maintenance activities that would occur 8 hrs per day for the RME and 1/2 of a day for the CT.

(2) Not available, used RME value.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

IN: Inhalation rates are based on values for the outdoor worker assuming heavy activity for the RME and moderate activity for the CT (page 5-24 of EPA, 1997).

TABLE 4.15

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*
Exposure Point: Yards of homes constructed within SWMU
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	see Table ----	--	see Table ----	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	EPA, 1991	50	EPA, 1993	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	
Dermal Absorption	CS	Chemical Concentration in Soil	mg/kg	see Table ----	--	see Table ----	--	CDI (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm^2	5,800	EPA, 1997	5,000	EPA, 1997	CS x SA x SSAF x DABS x CF3 x EF x
	SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.2	EPA, 1997	0.2	EPA, 1997	ED x 1/BW x 1/AT
	DABS	Dermal Absorption Factor Solids	--	chem specific	EPA, 1995	chem specific	EPA, 1995	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa; SSAF based on maximum adherence factor for gardeners.

DABS: Based on Region III Technical Guidance "Assessing Dermal Exposure from Soil, December 1995", for constituents not listed used volatile organics value of 20%, semi-volatile organics value of 10%, and Inorganics value of 1%.

SA: Based on 25% of total body surface area for adult (25% of 23,000 cm^2 for RME and 25% of 20,000 cm^2 for CT).

TABLE 4.16

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*
Exposure Point: Yards of homes constructed within SWMU
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	see Table ----	--	see Table ----	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	200	EPA, 1991	100	EPA, 1993	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	
	ED	Exposure Duration	years	6	EPA, 1991	6	(1)	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	BW	Body Weight	kg	15	EPA, 1991	15	EPA, 1991	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	EPA, 1989	2,190	EPA, 1989	
Dermal Absorption	CS	Chemical Concentration in Soil	mg/kg	see Table ----	--	see Table ----	--	CDI (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm^2	2,379	EPA, 1997	2,094	EPA, 1997	CS x SA x SSAF x DABS x CF3 x EF x
	SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.11	EPA, 1997	0.11	EPA, 1997	ED x 1/BW x 1/AT
	DABS	Dermal Absorption Factor Solids	--	chem specific	EPA, 1995	chem specific	EPA, 1995	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	
	ED	Exposure Duration	years	6	EPA, 1991	6	(1)	
	BW	Body Weight	kg	15	EPA, 1991	15	EPA, 1991	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	EPA, 1989	2,190	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa; SSAF based on maximum adherence factor for soccer players.

DABS: Based on Region III Technical Guidance "Assessing Dermal Exposure from Soil, December 1995", for constituents not listed used volatile organics value of 20%, semi-volatile organics value of 10%, and Inorganics value of 1%.

SA: Skin surface area for the RME is based on the 50th percentile total surface area for the child ages 5-6 years (Table 6-6 of EPA, 1999). The CT value is based on the average between the 50th percentile surface areas for the child ages 2-3 years and 5-6 years.

TABLE 4.17

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*
Exposure Point: Yards of homes constructed within SWMU
Receptor Population: Resident
Receptor Age: Child/Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	see Table --	--	see Table ----	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S-A	Ingestion Rate of Soil, Adult	mg/day	100	EPA, 1991	50	EPA, 1993	CS x IR-S-Adj x EF x CF3 x 1/AT
	IR-S-C	Ingestion Rate of Soil, Child	mg/day	200	EPA, 1991	100	EPA, 1993	
	IR-S-Adj	Ingestion Rate of Soil, Age-adjusted	mg-year/kg-day	114.29	calculated	46.43	calculated	IR-S-Adj (mg-year/kd-day) =
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	(ED-C x IR-S-C / BW-C) + (ED-A x IR-S-A / BW-A)
	ED-A	Exposure Duration, Adult	years	24	EPA, 1991	9	EPA, 1993	
	ED-C	Exposure Duration, Child	years	6	EPA, 1991	6	EPA, 1991	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	BW-A	Body Weight , Adult	kg	70	EPA, 1991	70	EPA, 1991	
	BW-C	Body Weight, Child	kg	15	EPA, 1991	15	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
Dermal Absorption	CS	Chemical Concentration in Soil	mg/kg	see Table --	--	see Table ----	--	CDI (mg/kg-day) =
	SA-A	Skin Surface Area Available for Contact, Adult	cm^2	5,800	EPA, 1997	5,000	EPA, 1997	CS x DA-Adj x DABS x CF3 x EF x 1/AT
	SA-C	Skin Surface Area Available for Contact, Child	cm^2	2,379	EPA, 1997	2,094	EPA, 1997	
	SSAF-A	Soil to Skin Adherence Factor	mg/cm^2-day	0.2	EPA, 1997	0.2	EPA, 1997	DA-Adj (mg-year/kd-day) =
	SSAF-C	Soil to Skin Adherence Factor	mg/cm^2-day	0.11	EPA, 1997	0.11	EPA, 1997	[(ED-C x SA-C x SSAF-C / BW-C) +
	DA-Adj	Dermal Absorption, Age-adjusted	mg-year/kg-day	calculated	--	calculated	--	(ED-A x SA-A x SSAF-A / BW-A)]
	DABS	Dermal Absorption Factor Solids	--	chem specific	EPA, 1995	chem specific	EPA, 1995	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	
	ED-A	Exposure Duration, Adult	years	24	EPA, 1991	9	EPA, 1993	
	ED-C	Exposure Duration, Child	years	6	EPA, 1991	6	EPA, 1991	
	BW-A	Body Weight , Adult	kg	70	EPA, 1991	70	EPA, 1991	
	BW-C	Body Weight, Child	kg	15	EPA, 1991	15	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	

TABLE 4.17

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*
Exposure Point: Yards of homes constructed within SWMU
Receptor Population: Resident
Receptor Age: Child/Adult

* Assumes subsurface soil could be excavated and spread over surface of site during development.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

DABS: Based on Region III Technical Guidance "Assessing Dermal Exposure from Soil, December 1995", for constituents not listed used volatile organics value of 20%, semi-volatile organics value of 10%, and Inorganics value of 1%.

TABLE 4.18

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*
Exposure Point: Areas within SWMU that may be developed
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	see Table ----		see Table ----	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	480	EPA, 1991	480	EPA, 1991	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	250	EPA, 1991	219	EPA, 1993	
	ED	Exposure Duration	years	1	EPA, 1991	1	EPA, 1991	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	365	EPA, 1989	365	EPA, 1989	
Dermal Absorption	CS	Chemical Concentration in Soil	mg/kg	see Table ----	--	see Table ----	--	CDI (mg/kg-day) =
	SA	*Skin Surface Area Available for Contact*	cm^2	*6,000*	EPA, 1997	*5,100*	EPA, 1997	*CS x SA x SSAF x DABS x CF3 x EF x*
	SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.24	EPA, 1997	0.24	EPA, 1997	ED x 1/BW x 1/AT
	DABS	Dermal Absorption Factor Solids	--	chem specific	EPA, 1995	chem specific	EPA, 1995	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	EF	Exposure Frequency	days/year	250	EPA, 1991	219	EPA, 1993	
	ED	Exposure Duration	years	1	EPA, 1991	1	EPA, 1991	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	365	EPA, 1989	365	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa; SSAF based on maximum adherence factor for construction workers.

DABS: Based on Region III Technical Guidance "Assessing Dermal Exposure from Soil, December 1995", for constituents not listed used volatile organics value of 20%, semi-volatile organics value of 10%, and Inorganics value of 1%.

SA: Skin surface area in contact with soil based on contact during construction activities. The total adult male surface area ranges from 17,000 to 23,000 cm^2, with a mean of 20,000 cm^2. The RME is based on 30% of the mean total adult male surface area (20,000 cm^2) or 6,000 cm^2 and the CT value is based on 30% of the 17,000 cm^2 or 51,000 cm^2.

TABLE 4.19

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*
Exposure Point: Unpaved areas within SWMU
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	see Table ----	- -	see Table ----	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	EPA, 1991	50	EPA, 1993	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	250	EPA, 1991	219	EPA, 1993	
	ED	Exposure Duration	years	25	EPA, 1991	5	EPA, 1993	
	CF3	Conversion Factor 3	kg/mg	0.000001	- -	0.000001	- -	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	EPA, 1989	1,825	EPA, 1989	
Dermal Absorption	CS	Chemical Concentration in Soil	mg/kg	see Table ----	- -	see Table ----	- -	CDI (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm^2	5,800	EPA, 1992	5,000	EPA, 1992	CS x SA x SSAF x DABS x CF3 x EF x
	SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.32	EPA, 1997	0.32	EPA, 1997	ED x 1/BW x 1/AT
	DABS	Dermal Absorption Factor Solids	--	chem specific	EPA, 1995	chem specific	EPA, 1995	
	CF3	Conversion Factor 3	kg/mg	0.000001	- -	0.000001	- -	
	EF	Exposure Frequency	days/year	250	EPA, 1991	219	EPA, 1993	
	ED	Exposure Duration	years	25	EPA, 1991	5	EPA, 1993	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	EPA, 1989	1,825	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa; SSAF based on maximum adherence factor for utility workers.

DABS: Based on Region III Technical Guidance "Assessing Dermal Exposure from Soil, December 1995", for constituents not listed used volatile organics value of 20%, semi-volatile organics value of 10%, and Inorganics value of 1%.

SA: Based on 25% of total body surface area for adult or 25% of 23,000 cm^2 for RME and 25% of 20,000 cm^2 for CT.

TABLE 4.20

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*
Exposure Point: Unpaved areas within SWMU
Receptor Population: Trespasser/Visitor
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	see Table ----	- -	see Table ----	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	EPA, 1991	50	EPA, 1993	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	52	(1)	26	(1)	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	
	CF3	Conversion Factor 3	kg/mg	0.000001	- -	0.000001	- -	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	
Dermal Absorption	CS	Chemical Concentration in Soil	mg/kg	see Table ----	- -	see Table ----	- -	CDI (mg/kg-day) =
	SA	Skin Surface Area Available for Cont	cm^2	5,800	EPA, 1992	5,000	EPA, 1992	CS x SA x SSAF x DABS x CF3 x EF x
	SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.2	EPA, 1997	0.2	EPA, 1997	ED x 1/BW x 1/AT
	DABS	Dermal Absorption Factor Solids	--	chem specific	EPA, 1995	chem specific	EPA, 1995	
	CF3	Conversion Factor 3	kg/mg	0.000001	- -	0.000001	- -	
	EF	Exposure Frequency	days/year	52	(1)	26	(1)	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

(1) Professional Judgement assuming 1 day per week for 52 weeks per year for the RME and 1/2 the RME value for the CT.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.

EPA, 1993: *Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.*

EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa; SSAF based on maximum adherence factor for gardeners.

DABS: Based on Region III Technical Guidance "Assessing Dermal Exposure from Soil, December 1995", for constituents not listed used volatile organics value of 20%, semi-volatile organics value of 10%, and Inorganics value of 1%.

SA: Based on 25% of total body surface area for adult or 25% of 23,000 cm^2 for RME and 25% of 20,000 cm^2 for CT.

TAF

VALUES USED FOR DAI[illegible]AKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*
Exposure Point: Unpaved areas within SWMU
Receptor Population: Trespasser/Visitor
Receptor Age: Adolescents

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	see Table ----	--	see Table ----	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	EPA, 1991	50	EPA, 1993	CS x IR-S x EF x ED x CF3 x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	52	(1)	26	(1)	
	ED	Exposure Duration	years	9	(2)	9	EPA, 1993	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	BW	Body Weight	kg	51	EPA, 1997,(3)	51	EPA, 1997,(3)	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,285	EPA, 1989	3,285	EPA, 1989	
Dermal Absorption	CS	Chemical Concentration in Soil	mg/kg	see Table ----	--	see Table ----	--	CDI (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm^2	4,500	EPA, 1997	2,500	EPA, 1997	CS x SA x SSAF x DABS x CF3 x EF x
	SSAF	Soil to Skin Adherence Factor	mg/cm^2-day	0.11	EPA, 1997	0.11	EPA, 1997	ED x 1/BW x 1/AT
	DABS	Dermal Absorption Factor Solids	--	chem specific	EPA, 1995	chem specific	EPA, 1995	
	CF3	Conversion Factor 3	kg/mg	0.000001	--	0.000001	--	
	EF	Exposure Frequency	days/year	52	(1)	26	(1)	
	ED	Exposure Duration	years	9	(2)	9	EPA, 1993	
	BW	Body Weight	kg	51	EPA, 1997,(3)	51	EPA, 1997,(3)	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,285	EPA, 1989	3,285	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

(1) Professional Judgement assuming 1 day per week for 52 weeks per year for the RME and 1/2 the RME value for the CT.

(2) Professional Judgement assuming adolescents from 9 to 18 years of age.

(3) Body weight is average value for the 9 year old and 18 year old mean male body weight.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1995: Assessing Dermal Exposure from Soil. EPA Region III. EPA/903-K-95-003.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa; SSAF based on maximum adherence factor for soccer players.

DABS: Based on Region III Technical Guidance "Assessing Dermal Exposure from Soil, December 1995", for constituents not listed used volatile organics value of 20%, semi-volatile organics value of 10%, and Inorganics value of 1%.

SA: The CT is based on 25% of the average surface area for 9-10 year old males and the RME is based on 25% of the average surface area for 17-18 year old males. (Tables 6-6 and 6-8; EPA, 1997).

TABLE 4.22

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air
Exposure Point: Yards of homes constructed within SWMU
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	see Table ----	- -	see Table ---	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
	CA	Chemical Concentration in Air	mg/m^3	see Table ----	- -	see Table ---	- -	CA x IN x ET x EF x ED x 1/BW x 1/AT
	PEF	Particulate Emissions Factor	kg/m^3	1.32E+09	EPA, 1996	1.32E+09	EPA, 1996	
	VF	Volatilization Factor for volatile constituents	m^3/kg	chem specific	EPA, 1996	chem specific	EPA, 1996	
	IN	Inhalation Rate	$m^3/hour$	0.83	EPA, 1999	0.83	EPA, 1999	
	ET	Exposure Time	hr/day	24	(1)	24	(1)	CA (mg/m^3) = CS (1/PEF + 1/VF)
	EF	Exposure Frequency	days/year	350	EPA, 1991	219	EPA,1993	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

(1) Professional Judgement, conservatively assumed all day.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.

EPA, 1999: Region III Risk-Based Concentration Table. October 27, 1999.

TABLE 4.23

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air
Exposure Point: Yards of homes constructed within SWMU
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	see Table ----	--	see Table ---	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	CA	Chemical Concentration in Air	mg/m^3	see Table ----	--	see Table ---	--	CA x IN x ET x EF x ED x 1/BW x 1/AT
	PEF	Particulate Emissions Factor	kg/m^3	1.32E+09	EPA, 1996	1.32E+09	EPA, 1996	
	VF	Volatilization Factor for volatile constituents	m^3/kg	chem specific	EPA, 1996	chem specific	EPA, 1996	
	IN	Inhalation Rate	$m^3/hour$	0.5	EPA, 1999	0.5	EPA, 1999	
	ET	Exposure Time	hr/day	24	(2)	24	(2)	CA (mg/m^3) = CS (1/PEF + 1/VF)
	EF	Exposure Frequency	days/year	350	EPA, 1991	219	EPA, 1993	
	ED	Exposure Duration	years	6	EPA, 1991	6	(1)	
	BW	Body Weight	kg	15	EPA, 1991	15	EPA, 1991	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	EPA, 1989	2,190	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

(1) Not available, used RME value.

(2) Professional Judgement conservatively assumed all day.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.

EPA, 1999: Region III Risk-Based Concentration Table. October 27, 1999.

TABLE 4.24

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air
Exposure Point: Yards of homes constructed within SWMU
Receptor Population: Resident
Receptor Age: Child/Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	see Table 3	see Table 3	see Table 3	see Table 3	Chronic Daily Intake (CDI) (mg/kg-day) =
	CA	Chemical Concentration in Air	mg/m^3	see Table ----	- -	see Table ---	- -	CA x IN-Adj x EF x 1/AT
	FDC	Fugivite Dust Concentration in Air	kg/m^3	1.32E+09	EPA, 1996	1.32E+09	EPA, 1996	
	VF	Volatilization Factor for volatile constituents	m^3/kg	calc	EPA, 1996	calc	EPA, 1996	CA (mg/m^3) = CS (1/PEF + 1/VF)
	IN-A	Inhalation Rate, Adult	m^3/hour	0.83	EPA, 1991	0.83	EPA, 1991	
	IN-C	Inhalation Rate, Child	m^3/hour	0.5	EPA, 1999	0.5	EPA, 1999	IN-Adj (m^3-year/kd-day) =
	IN-Adj	Inhalation Rate, Age-adjusted	m^3-year/kg-day	11.66	calculated	7.37	calculated	(ED-C x IN-C x ET / BW-C) + (ED-A x IN-A x ET / BW-A)
	ET	Exposure Time	hours/day	24	(1)	24	(1)	
	EF	Exposure Frequency	days/year	350	EPA, 1991	234	EPA, 1993	
	ED-A	Exposure Duration, Adult	years	24	EPA, 1991	9	EPA, 1993	
	ED-C	Exposure Duration, Child	years	6	EPA, 1991	6	EPA, 1991	
	BW-A	Body Weight , Adult	kg	70	EPA, 1991	70	EPA, 1991	
	BW-C	Body Weight, Child	kg	15	EPA, 1991	15	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

(1) Professional Judgement conservatively assumed all day.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1992: Dermal Exposure Assessment: Principals and Applications. ORD. EPA/600/8-91/011B.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1999: Region III, Risk-based Concentration Table.

TABLE 4.25

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air
Exposure Point: Areas within SWMU that may be developed
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	see Table ----	- -	see Table ---	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
	CA	Chemical Concentration in Air	mg/m^3	see Table ----	- -	see Table ---	- -	CA x IN x ET x EF x ED x 1/BW x 1/AT
	PEF	Particulate Emissions Factor	kg/m^3	calc	(1)	calc	(1)	
	VF	Volatilization Factor for volatile constituents	m^3/kg	calc	EPA, 1996	calc	EPA, 1996	
	IN	Inhalation Rate	$m^3/hour$	2.5	EPA, 1997	1.5	EPA, 1997	
	ET	Exposure Time	hr/day	8	(2)	4	(2)	CA (mg/m^3) = CS (1/PEF + 1/VF)
	EF	Exposure Frequency	days/year	250	EPA,1991	219	EPA, 1993	
	ED	Exposure Duration	years	1	EPA, 1991	1	EPA, 1991	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	365	EPA, 1989	365	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

(1) Calculated in Appendix--- Section Generation of Fugitive Dust During Construction Activites.

(2) Professional Judgement based on maintenance activities that would occur 8 hrs per day for the RME and 1/2 of a day for the CT.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

IN: Inhalation rates are based on values for the outdoor worker assuming heavy activity for the RME and moderate activity for the CT (page 5-24 of EPA, 1997).

TABLE 4.26

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air
Exposure Point: Unpaved areas within SWMU
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	see Table ----	--	see Table ---	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	CA	Chemical Concentration in Air	mg/m^3	see Table ----	--	see Table ---	--	CA x IN x ET x EF x ED x 1/BW x 1/AT
	PEF	Particulate Emissions Factor	m^3/kg	1.32E+09	EPA, 1996	1.32E+09	EPA, 1996	
	VF	Volatilization Factor for volatile constituents	m^3/kg	calc	EPA, 1996	calc	EPA, 1996	
	IN	Inhalation Rate	$m^3/hour$	0.83	EPA, 1999	0.83	EPA, 1999	
	ET	Exposure Time	hr/day	8	(1)	4	(1)	CA (mg/m^3) = CS (1/PEF + 1/VF)
	EF	Exposure Frequency	days/year	250	EPA,1991	219	EPA, 1993	
	ED	Exposure Duration	years	25	EPA, 1991	5	EPA., 1993	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	EPA, 1989	1,825	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

(1) Professional Judgement based on maintenance activities that would occur 8 hrs per day for the RME and 1/2 of a day for the CT.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.

EPA, 1999: Region III Risk-Based Concentration Table. October 27, 1999.

TABLE 4.27

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air
Exposure Point: Unpaved areas within SWMU
Receptor Population: Trespasser/Visitor
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	see Table ----	- -	see Table ---	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
	CA	Chemical Concentration in Air	mg/m^3	see Table ----	- -	see Table ---	- -	CA x IN x ET x EF x ED x 1/BW x 1/AT
	PEF	Particulate Emissions Factor	m^3/kg	1.32E+09	EPA, 1996	1.32E+09	EPA, 1996	
	VF	Volatilization Factor for volatile constituents	m^3/kg	chem specific	EPA, 1996	chem specific	EPA, 1996	
	IN	Inhalation Rate	m^3/hour	0.83	EPA, 1999	0.83	EPA, 1999	
	ET	Exposure Time	hr/day	1.8	(1)	1.8	(1)	CA (mg/m^3) = CS (1/PEF + 1/VF)
	EF	Exposure Frequency	days/year	52	(2)	26	(2)	
	ED	Exposure Duration	years	24	EPA, 1991	9	EPA, 1993	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	EPA, 1989	3,285	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

(1) Professional Judgement assuming trespasser would spend a maximum of 1.8 hours at the site.

(2) Professional Judgement assuming 1 day per week for 52 weeks per year for the RME and 1/2 the RME value for the CT.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.

EPA, 1999: Region III Risk-Based Concentration Table. October 27, 1999.

TABLE 4.28

VALUES USED FOR DAILY INTAKE CALCULATIONS

SWMU 2B - NAS Oceana

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Air
Exposure Point: Unpaved areas within SWMU
Receptor Population: Trespasser/Visitor
Receptor Age: Adolescents

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	see Table ----	- -	see Table ---	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
	CA	Chemical Concentration in Air	mg/m^3	see Table ----	- -	see Table ---	- -	CA x IN x ET x EF x ED x 1/BW x 1/AT
	PEF	Particulate Emissions Factor	m^3/kg	1.32E+09	EPA, 1996	1.32E+09	EPA, 1996	
	VF	Volatilization Factor for volatile constituents	m^3/kg	chem specific	EPA, 1996	chem specific	EPA, 1996	
	IN	Inhalation Rate	m^3/hour	0.83	EPA, 1999	0.83	EPA, 1999	
	ET	Exposure Time	hr/day	1.8	(1)	1.8	(1)	CA (mg/m^3) = CS (1/PEF + 1/VF)
	EF	Exposure Frequency	days/year	52	(2)	26	(2)	
	ED	Exposure Duration	years	9	(3)	9	EPA, 1993	
	BW	Body Weight	kg	51	EPA, 1997,(3)	51	EPA, 1997,(3)	
	AT-C	Averaging Time (Cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,285	EPA, 1989	3,285	EPA, 1989	

* Assumes subsurface soil could be excavated and spread over surface of site during development.

(1) Professional Judgement assuming trespasser would spend a maximum of 1.8 hours at the site.

(2) Professional Judgement assuming 1 day per week for 52 weeks per year for the RME and 1/2 the RME value for the CT.

(3) Body weight is average value for the 9 year old and 18 year old mean male body weight.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1996: Soil Screening Guidance: User's Guide. OSWER. EPA/540/R-96/018.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 1999: Region III Risk-Based Concentration Table. October 27, 1999.